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ORIGINAL PAPER

# On the double nature of productivity in inflectional morphology

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**Abstract** Inflection is generally considered to be more productive than derivation. To justify such an assumption, the syntactic function of inflectional morphology is contrasted with the mainly lexical function of derivational morphology. In this paper, the whole question will be carefully discussed with the help of recently developed quantitative approaches to productivity. On the basis of data taken from Italian, it will be shown that a quantitative approach to productivity can shed light on this intricate question by revealing the double nature of inflectional morphology, which on the one hand sides with derivational morphology because of its lexically conditioned inflectional classes. On the other, it scores very high productivity rates for the single inflectional categories in accordance with its syntactic function. Furthermore, the productivity rates of the inflectional categories considered are shown to be not uniform: several factors may influence their productivity, as for instance the substitutive usage of periphrases with modals, even in a language like Italian in which the latter are far less grammaticalized than in others.

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## 1 Introduction

It is almost a common place in theoretical morphology to consider inflection to be generally more productive than derivation. Similar statements can be found in many overviews discussing the main differences between inflection and derivation. To justify such an assumption, the main function of inflectional morphology is usually invoked, which generally produces word forms to be used in syntax. The syntactic function of inflectional morphology is contrasted with the mainly lexical function of derivational morphology, which contributes to lexical enrichment. These distinct functions are usually taken to be one of the most relevant criteria distinguishing inflection from derivation. Clearly related to the idea of a syntactically determined component producing word forms is also the notion of paradigm, which is central for inflectional morphology, whereas its role in derivational morphology is at least debatable. From this point of view, it is generally much easier to speak of inflectional categories than of derivational categories, the latter being subject to a number of restrictions and gaps which strongly undermine the heuristic validity of the concept (cf. Rainer 2000 for a survey).

On the other hand, at least in fusional languages inflectional morphology also displays a number of restrictions of a lexical nature, in that inflectional classes may condition the morphological behavior of a lexeme in ways that resemble derivational, i.e., lexically conditioned, morphology. In order to tease these two perspectives apart, the double nature of inflectional morphology needs to be distinguished. On the one hand, the syntactic function of inflection requires a maximization of the productivity of the inflectional categories in order to supply syntax with the required word forms. On the other, lexically conditioned inflectional classes may display considerably different productivity values, which may also be smaller than those of derivational morphology.

In this paper, the question of productivity in inflectional morphology will be carefully discussed with the help of recently developed quantitative, corpus-based approaches to productivity. In particular, the so-called variable-corpus approach developed in Gaeta and Ricca (2006) on the basis of the original procedure suggested by Baayen (1989) will be shown to provide an optimal frame for investigating the productivity of inflectional morphology. Relying on data taken from the verbal morphology of a richly inflecting language like Italian, it will be shown that the variable-corpus approach to productivity can shed light on this intricate question by concretely revealing the double nature of inflectional morphology. On the one hand, the productivity values side with those of derivational morphology because of the lexically conditioned inflectional classes, while on the other the productivity rates of the inflectional categories are very high in accordance with their syntactic function.

Interestingly enough, however, the productivity rates are not uniform across the inflectional categories considered: the quantitative approach helps us to discover for the first time that several factors may influence the productivity of the different inflectional categories. In particular, inherent inflectional categories expressing non-objective content are exposed to a substitutive effect by modals, even in a language like Italian in which they are far less grammaticalized than in others.

The paper is structured as follows: Sect. 2 gives a survey of the theoretical debate about the inflection/derivation continuum, in which limits on the productivity of inflectional rules are often confused with limits on the productivity of inflectional categories; Sect. 3 introduces the recently developed quantitative approaches to productivity, which are exploited in Sect. 4 to provide a quantitative evaluation of the inflection/derivation continuum; the same methods are then applied respectively in Sect. 5 to the lexically conditioned side and in Sect. 6 to the syntactically conditioned side of inflection. The final Sect. 7 draws the conclusion.

## 2 Productivity across the inflection/derivation continuum

In most survey papers discussing the inflection/derivation distinction, productivity is mentioned as an important distinguishing property in that inflection is generally held to be more productive than derivation (e.g., Plank 1981, p. 14; Scalise 1984, p. 114; Wurzel 1984, pp. 43f., p. 47; Bybee 1985, pp. 83ff., Bauer 1988, p. 15; Dressler 1989, p. 7; Plank 1994, p. 1675; Wurzel 1996, pp. 268f., Stump 1998, p. 16; Booij 2000, pp. 363f., Koefoed and van Marle 2000, pp. 303f., Haspelmath 2002, p. 71).

The reason invoked to account for this difference may be more or less left implicit, but has basically to do with the main function of inflection to provide word forms to be used in syntax. So, for instance, Stump (1998, p. 16) claims that ''inflection is generally more productive than derivation'', and substantiates his claim by observing that ''an arbitrarily chosen count noun virtually allows an inflected plural form'' in English, whereas ''an arbitrarily chosen adjective may or may not give rise to a related causative verb (e.g., *harden*, *deafen*, but not **colden*, **braven*)''. The reason is that count nouns can be straightforwardly used as plurals in an appropriate syntactic context: in other words, they undergo syntactic determination, which is Stump's second criterion distinguishing inflection and derivation, whereas causatives are not syntactically determined in any meaningful sense.

This is only partially correct, however, because the reader is left with the doubt that two different categories are being compared: on the one hand, the category of plurality, independently of the single markers realizing it (i.e., *-s*, *-en*, etc.), and on the other the causative suffix *-en*. In fact, Stump's observation refers to the way of deriving nouns and adjectives as for plurality and causativity. However, other suffixes besides *-en*, which happens to be scarcely productive, also form causatives in a fairly productive way (e.g., *-ize*, cf.

*randomize*, *realize*, etc.), and the risk of a confusion between the two different concepts is real.

Furthermore, plurality for nouns is not syntactically determined *stricto sensu*, because it has to be considered an instance of inherent inflection as opposed to contextual inflection, which is purely syntactically motivated, e.g., case for nouns or number for verbs (cf. Booij 1996). Inherent inflection conveys a certain amount of independent information and is not necessarily forced by the syntactic context. Accordingly, it is expected to be more sensitive to semantic restrictions than contextual inflection. This inherent inflectional nature of plurality for nouns is also implicit in the restriction mentioned by Stump that only count nouns undergo pluralization.

Plank (1994, p. 1675) is well aware of this aporia, when he claims: ''Any English verb, regardless of its form and meaning even if newly coined on the spur of the moment, can be put in the 3rd person singular present indicative; moreover, such complex forms will not strike anyone as more unfamiliar than their base. All other categories are less productive''. In fact, Plank's productivity criterion, whereby ''[t]he applicability of the morphological category to bases of particular word-classes is (a) unlimited or (b) limited in one way or another'', is a basic one among his other criteria delimiting prototypical inflection in a clearcut way.[1] Limits on productivity are given by the fact that

> ''(a) bases of the relevant kind do not include all words of the respective word-classes but only semantic subsets of them, (b) particular phonological and morphological factors tend to discourage, or encourage the formation of C[omplex]N[on]C[ompound]W[ord]s, or (c) novel CNCWs, even if formed from bases of the relevant kind and not discouraged by any phonological or morphological factors, will simply be found so unfamiliar as to attract notice.

With respect to the 3rd person singular present indicative, the plural is subject to more limitations, given that ''only count nouns are pluralizable'', and that there are ''many nouns, mostly abstract or collective ones, which resist pluralization or sound or look unfamiliar (e.g., *knowledge*, *luck*, *help*, *information*, *thunder*, *produce*, *macaroni*, *chaos*)''. Thus, the subcriteria (a) and (c) are violated by the less prototypical inflectional rule of plural.

Plank's discussion of these two inflectional rules as more or less productive allows one to do justice of a misunderstanding related to the concept of semi-productivity which has been used by Matthews (1991, pp. 49–54, 69ff.; cf. Bauer 2001, pp. 16–17 for criticism) and recently advocated by Jackendoff (1997,

[1] The other three criteria mentioned by Plank which define prototypical inflection are exponence cumulation, semantic transparency, and base transparency, namely the property for a derivative of being derived from an existing autonomous base. There are many other criteria distinguishing inflection and derivation. The four criteria mentioned here delimit the realm of prototypical inflection (Plank's concrete example is the 3rd person singular of English verbs) as opposed to less prototypical or unprototypical inflection and of course to derivation.

pp. 115–121) as a main difference between inflection and derivation. Again, inflection is claimed to be productive because it involves features that are independently active in syntax. On the other hand, derivation has to do with the lexicon which does not presuppose productivity: "An inflectional form *must* provide a set of derived forms for all stems of the requisite sort, whereas a derivational process may or may not" (Jackendoff 1997, p. 121). In this case, semi-productivity arises when "we don't know exactly what the output of a rule is in a particular case" (Jackendoff 1997, p. 115).[2] Accordingly, semi-productivity is mostly attributed to derivation, although it is claimed that there is some process of derivation displaying full productivity like the so-called English expletive infixation occurring in coinages such as *auto-fuckin-matic* (cf. Jackendoff 1997, p. 119). Independently of the reliability of this example, which rather looks like an instance of extra-grammatical morphology (cf. Dressler 2001), the following conclusion is drawn from this distinction:

> "The distinction between productive and semiproductive processes cuts across the inflectional/derivational distinction. Although an inflectional process must provide derived forms for all stems, at least some of these forms may be provided by semiproductive processes or even suppletion, as is the case with the English past tense. Conversely, a derivational process may be entirely productive, as evidenced by expletive infixation" (Jackendoff 1997, p. 121).

What is questionable in this view is Jackendoff's collapsing the syntactic productivity of an inflectional category manifested by an inflectional rule together with the lexical conditioning of the inflectional class relating to that rule, very much like in Stump's examples seen above. In this respect, Plank's approach focuses in a much more adequate way on limits on the productivity of inflection which are strictly related to the applicability of the inflectional category of plurality to the set of theoretically conceivable bases.

Notice that distinguishing the syntactic productivity of an inflectional rule from its lexical conditioning is particularly important from a typological point of view, because it might well be the case that languages do not display lexical conditioning of inflectional rules at all. Collapsing the two concepts together would hinder the comparison between fusional languages, in which lexical conditioning is generally present, and agglutinative languages, in which such a conditioning does not generally occur. This sounds quite paradoxical, because it implies that the syntactic productivity of inflectional morphology is lexically restricted in fusional languages, while it can only show up freely in agglutinative languages. This latter conclusion is clearly wrong, because English morphology does allow one to form the past tense for every verb, independently of the

[2] Bauer (2001, p. 17) comments here that "[t]his formulation is difficult to interpret, since a 'rule' which can give rise to an unknowable output must be a very different kind of rule from that normally denoted by the term".

coding strategy adopted. From this point of view, agglutinative and fusional languages must be fully comparable.[3]

However, one does not feel completely comfortable with the concrete examples given by Plank, since he is comparing a single inflectional rule (the 3rd person singular present indicative) with an inflectional category, namely the noun plural. In fact, Plank disregards that there are indeed limits on the applicability of the 3rd person singular present indicative: modals for instance display a zero marker. This again engenerates the confusion between comparing inflectional classes and inflectional categories. In fact, plural is simply incompatible with a noun like *knowledge*, whereas one might argue that modals belong to a certain inflectional class displaying a zero marker in that paradigm slot. It is fully legitimate to observe with Bauer (1994, p. 3357) that: "[t]here is a certain amount of vagueness as to what it is exactly which is supposed to be productive: is it the actual affix, the morph, or the morpheme of which that affix is representative?"

To tease the two different perspectives apart, Haspelmath (2002, p. 133) recognizes the intrinsic difference of the concept of productivity when applied to inflection and derivation:

> "Like word-formation patterns, inflection classes may be more or less productive, but the productivity criterion of applicability to new bases must be used in a somewhat different way than in word-formation. In word-formation, a new base can be an existing word that has simply never been used before with a certain pattern, but in inflection this does not work, because all lexemes are expected to have inflected forms for all categories".

In this way, Haspelmath restricts the domain of his concept of productivity, i.e., the applicability to new bases, to two main cases, namely the ability of attracting new members by inflectional class shift, and the ability of applying to novel lexemes that come into a language, either as loanwords or as neologisms formed by productive word-formation rules. In other words, he's talking about the productivity of the single inflectional classes realizing inflectional categories. To draw a comparison with derivation, Haspelmath is comparing the productivity of single affixes like *-ion* or *-al* within the derivational category of action nouns. English engenerates a certain confusion because of its poor inflectional morphology, in which a single class often almost coincides with one inflectional category, as is the case with the 3rd singular person of the present indicative, if the small inflectional class of modals is neglected.

[3] This cuts across the question of defectiveness, which will be discussed below. Although this question is for a number of reasons still obscure, it is clear that it concerns both agglutinative and fusional languages. For a discussion with examples from agglutinative languages see Corbett (2000, pp. 175–176). Furthermore, I am abstracting away from cases of defectiveness due to an uncomplete integration of a borrowed lexeme into a morphological system. As observed by an anonymous reviewer, this may also lead to restrictions on the applicability of an inflectional category. For some reflections on this subject see Dressler (2003).

It is quite surprising that, when discussing productivity, Haspelmath does not mention the question raised by Plank that inflectional categories may sometimes display limits on productivity. One extreme case is defectiveness, as mentioned by Booij (2000, p. 362) surveying the differences between inflection and derivation, in which we find paradigmatic gaps occurring with certain lexemes for which some inflectional forms are not available. For instance, the Italian verb *prorompere* 'burst out' does not form the past participle **prorotto*, even though it belongs to a lexical nest of verbs normally showing the past participle: *rompere* 'break'/*rotto*, *corrompere* 'corrupt'/*corrotto*, *interrompere* 'interrupt'/*interrotto*, etc. When illustrating defectiveness, Haspelmath (2002, p. 142) does mention the fact that "[n]ormally there is at least one productive pattern for each inflectional category, a **default** pattern that is used when no other pattern is remembered". However, he does not draw any conclusion about the connection of this default pattern, which is correctly attributed to the inflectional category, with the productivity of inflectional classes discussed earlier in the chapter.

In my view, the main source of confusion seems to reside in the double nature of inflection, which is on the one hand related to (or interfaced with) syntax, given that it produces word forms to be used in syntactic contexts, and on the other to the lexicon, because words may be grouped into inflectional classes which compete within a given inflectional category. Given this Ianus-face, an apparently contradictory behavior is observed. Because of its syntactic function, higher productivity rates are expected for inflection with respect to derivation. This is the empirical consequence of Haspelmath's idea of a default pattern. On the other hand, lexical conditions may force an inflectional rule to be less productive than a derivational one. For instance, it is clear that the *-en* plural in English (e.g., *ox —oxen*) is unproductive if compared to the *-s* plural. To solve this apparent paradox, we have to carefully distinguish between inflectional categories, which are in general more productive than derivation, and inflectional rules, which may or may not be more productive than derivation. In the next sections I will try to give an empirical basis to this claim, in that inflectional rules will be investigated separately from inflectional categories.

## 3 Quantitative approaches to productivity

In the last decade, an approach basically developed by Baayen and his collaborators (cf. Baayen 1989, 1992, 1993, 2001; see also Baayen and Lieber 1991; Baayen and Renouf 1996; Plag et al. 1999) has attempted to provide a quantitative measure of productivity making use of wide text corpora. The basic idea is to consider productivity as resulting from *h/N*, namely as the relation between the so-called hapax legomena *h*, i.e., words formed with a certain affix occurring with frequency 1 in the corpus, and the number *N* of tokens formed with that affix in the corpus. This index provides the probability that a new formation *h* with that affix comes out after counting *N* tokens of a certain affix.

It would take too much space to discuss the details concerning this approach, which has been subjected to several criticisms (cf. Bauer 2001, pp. 147–156 for a critical survey). One aspect which has been objected to Baayen's productivity index (= *P*-index) is that comparing, as he does, productivity values of affixes collected on the basis of the whole corpus presents the drawback of overestimating the productivity of the low-frequency affixes with respect to the much more frequent ones (cf. van Marle 1992). This effect is due to the decreasing character of the monotonic function *P(N)*, namely the function plotting the *P*-index as a function of the token number, which even tends to zero when *N* approaches infinity, as pointed out by Baayen and Lieber (1991, p. 837). In simpler terms, this amounts to saying that when calculating the *P*-index one usually finds at the beginning of the sampling process a large number of hapax legomena which decreases steeply as long as the sampling proceeds. This effect is due to the fact that at the very beginning of the sampling process *every* type is a hapax legomenon. The decrease of the *P(N)* curve becomes less steep with the increase of the sampling, i.e., of the token number, simply because the number of types displaying a certain affix becomes after a certain sampling point large enough to allow only a limited number of hapax legomena, which is near to zero for unproductive affixes. Notice that this effect is expected for any affix, independently of its productivity.[4]

Given the differences in frequency terms among affixes, if the productivity values are calculated on the basis of the total token numbers sampled in the whole corpus as done by Baayen, then low frequency affixes, whose productivity values lie at the very beginning of their decreasing *P(N)* curves, are strongly enhanced with respect to high frequency affixes, whose productivity values lie at a much lower point of their decreasing *P(N)* curves. This is, however, not due to the *P*-index by itself, i.e., to the probability of finding a new type displaying a certain affix, namely a *h*, but to the fact that high frequency affixes have simply "consumed" much more tokens and types than low frequency affixes within one and the same corpus. This consumption effect, however, does not say anything about the productivity of an affix, given that high frequency affixes may be productive as well as unproductive, as is the case for the Italian suffixes *-mento* and *-(z)a* to be shown in Table 5. In other words, the *P*-index as such is independent of the size of the lexical reservoir of a certain affix, in that the type number does not play any direct role.

To avoid such inconsistencies and to keep the frequency effect under control, it is necessary to compare the productivity values of the affixes when they reach the same token number in the corpus, namely when they are at the same point of their decreasing *P(N)* curves. In order to do that, the token number for the single affixes must be calculated on the basis of different subcorpora extracted from the same corpus because the frequency values are different for the single affixes. To make the variable-corpus approach feasible, the corpus must be structured in single text chunks that can be computed separately, providing

[4] Gaeta and Ricca (2006, p. 63) demonstrate the empirical validity of this claim for four Italian suffixes displaying different productivity rates.

subcorpora matching the required value $N$ for different affixes. Such a design underlies the corpus of 75,000,000 tokens representing three years 1996–1998 of the Italian newspaper *La Stampa* which has been used for investigating word formation in Italian and will also be the source for the investigation carried out in this contribution. As also observed by Baayen and Renouf (1996), the daily issues of a newspaper are an optimal test bed to investigate productivity exactly because of its increasing character. The corpus worked out in Gaeta and Ricca (2002, 2003, 2006) is structured in 36 text chunks corresponding to the monthly issues of the newspaper, so that they can be computed separately. This allows us to extract data for affixes displaying different frequencies computing different text chunks. For instance, the two Italian suffixes *-(z)ione* and *-(z)a* display different frequency values of 13.9‰ and 2.8‰, respectively. In order to compute the respective *P*-index of the two suffixes at an equal token number, say 100,000, it is necessary to extract values from text chunks of 3 and 17 months, respectively. The direct comparison is made possible by the overall constant frequency of the affixes throughout the whole corpus, as shown in Gaeta and Ricca (2006, p. 65).

To have an idea of how the variable-corpus approach works with respect to the original Baayen's procedure, let me briefly discuss the case of two inflectional rules for which we should normally expect to obtain identical productivity values because of their purely contextual nature, namely the third person singular and plural of the imperfect indicative of the Italian *a*-verbs (e.g., *parl-ava* 'she was speaking' versus *parl-avano* 'they were speaking'). Given their contextual nature, they are the prototypical example of inflection required by syntax for which a similarly unconstrained productivity is likely to be predicted. Baayen's procedure assumes the total token number $N_{max}$ for both suffixes, and the *P*-index is calculated accordingly (Table 1).[5]

Since the singular *-ava* is about three times more frequent than the plural *-avano*, the *P*-index turns out to strongly favor the plural with respect to the singular by a ratio of 3:1 which corresponds to the different frequency of the

**Table 1** Productivity evaluation for Italian 3.ps.sg. and pl.impf.ind. (Baayen's approach)

| Suffixes | $P(N_{max}) \cdot 10^3$ | $N_{max}$ | $V(N_{max})$ | $h(N_{max})$ |
|---|---|---|---|---|
| *-ava* | 6.4 | 104,642 | 2,736 | 673 |
| *-avano* | 18.1 | 35,780 | 2,048 | 649 |

[5] The data reported below and in the rest of the paper reproduce what can be directly extracted from the corpus. An anonymous reviewer questions the reliability of these data, which have not been normalized adopting statistical models of sampling like those for instance suggested by Baayen (2001). Besides theoretical preferences for having real data, Gaeta and Ricca (2006, p. 73) have shown that there are no substantial differences between *P*-values calculated on real data and *P*-values calculated via the binomial interpolation procedure (cf. Baayen 2001, pp. 63, 65). The latter takes as input the whole frequency spectrum of each affix calculated at full corpus, from which a computational procedure provided in the CD-ROM enclosed with Baayen's book (cf. Baayen 2001, pp. 223–225) allows one to extract the expectation values for *h(N)*. Given that both data roughly converge, I will take the real data as my primary source.

**Table 2** Productivity evaluation for Italian 3.ps.sg. and pl.impf.ind. (variable-corpus approach)

| | $P(N) \cdot 10^3$ | |
|---|---|---|
| Suffixes | $N = 19{,}474$ | $N = 35{,}780$ |
| *-ava* | 32.3 | 18.1 |
| *-avano* | 31.7 | 18.1 |

suffixes. This is quite a strange result, because there is apparently no linguistic reason why the former should be less productive than the latter. The effect, clearly due to the different frequency values of the suffixes, disappears if the *P*-index is calculated at a fixed token number for both suffixes, which implies that correspondigly different subcorpora must be taken for correctly comparing the *P*-values. Since the frequency ratio between *-ava* and *-avano* is about 3:1, a subcorpus of 6 months issues of the newspaper constituting my corpus was taken for measuring the *P*-value for the singular *-ava* at $N = 19{,}474$, which precisely corresponds to the value extracted for measuring the *P*-index of the plural *-avano* from a subcorpus of 19 months. Given that for each affix a curve *P(N)* can be drawn by fitting the discrete values calculated on the subcorpora, the values for a fixed value of *N*, say $N_{0,}$ can be obtained by interpolation.[6] Furthermore, in order to check the reliability of the data given the decreasing character of the *P(N)* curve, the *P*-values were also calculated for both suffixes at $N = 35{,}780$, which corresponds to the value extracted for *-avano* from the whole 36 months corpus and to the value extracted from a subcorpus consisting of 12 months plus the necessary interpolation for the more frequent *-ava* (Table 2).

As shown in the table, the *P*-values roughly converge. Despite the decreasing character of the function *P(N)*, the *P*-index keeps matching. Besides confirming the improvement represented by the variable-corpus approach with respect to Baayen's original procedure, the results reported in the table are interesting for another reason: if the *P*-values would basically converge for different persons of the same inflectional category, in our case the imperfect indicative, it would not make any difference to calculate the *P*-index for a single person of the category or for the whole set of the six persons forming the paradigm of the imperfect indicative. Besides saving a lot of work, this result would be comforting because we would be sure that we are in fact measuring the productivity of the imperfect indicative and not, say, of the third person singular with respect to the plural. In order to assess this issue, a comparison with the *P*-values calculated for all six persons of the imperfect indicative of this verb class was carried out (Table 3).

[6] The data reported in the following table as well as in the rest of the paper are obtained by fitting the data with a power regression curve. Although this choice is not fully adequate theoretically (for a discussion see Baayen 1989, pp. 105–106), from a practical point of view it gives satisfactory results as long as interpolations and not extrapolations are involved (the coefficients of determination $R^2$ are around 0,99). For my purposes, Gaeta and Ricca (2006, pp. 66, 85) verified that in most instances even a linear interpolation between the values of *P(N)* taken from two contiguous subcorpora (say, of 5 and 6 months) gives nearly identical results.

**Table 3** Productivity evaluation for the Italian imperfect indicative (variable-corpus approach)

| | $P(N) \cdot 10^3$ | |
|---|---|---|
| Suffixes | $N = 19{,}474$ | $N = 35{,}780$ |
| *-ava* | 32.3 | 18.1 |
| *-avano* | 31.7 | 18.1 |
| *-av-* | 33.0 | 18.4 |

**Table 4** Productivity evaluation for the Italian imperfect indicative (Baayen's approach)

| Suffixes | $P(N_{max}) \cdot 10^3$ | $N_{max}$ | $h(N_{max})$ |
|---|---|---|---|
| *-ava* | 6.4 | 104,642 | 673 |
| *-avano* | 18.1 | 35,780 | 649 |
| *-av-* | 4.1 | 153,930 | 637 |

Even considering all persons of the imperfect indicative, we roughly obtained converging results, which again speaks in favor of our interpretation of the data, namely that we can roughly utilize the 3.ps.sg. as representative of the whole inflectional category. At the same time, these data also support the variable-corpus approach.

A final argument in support of the variable-corpus approach comes from a comparison with a further productivity measure proposed by Baayen (1992, 1993), the so-called hapax-conditioned global productivity, which basically amounts to calculating the total number of hapax legomena occurring with a certain affix in the whole corpus. As pointed out by Bauer (2001, p. 155), this index presents difficulties of a theoretical nature, because it actually "asks 'What proportion of new coinages use affix A?' rather than asking 'What proportion of words using affix A are new coinages?'. It is this latter which seems a more relevant question to ask".

In spite of this basic theoretical weakness, it is true that empirically this index strongly correlates with the *P*-values of derivational affixes calculated following the variable-corpus procedure (cf. Gaeta and Ricca 2006, pp. 73–74). However, doubts are cast on its reliability by the different values of *h* given in the Table 4.

Besides the highly diverging $P(N_{max})$ values, the significant differences among the values of *h* displayed in the table are clearly due to the more frequent affix *-ava* which is favored against the others. From a linguistic point of view, these differences are hardly understandable, unless one assumes that the 3.ps.sg. should be for some mysterious reason more productive than the whole category! This distorting effect, clearly due to frequency, disappears if the variable-corpus procedure is adopted, as shown in Table 3.[7]

[7] The values of *h* also correlate badly with the *P*-indexes calculated in Table 3: $r = 0.36$ for *P* calculated at $N = 19{,}474$ and $r = 0.75$ for *P* calculated at $N = 35{,}780$. Further evidence against the hapax-conditioned global productivity is discussed in Gaeta and Ricca (2003, pp. 108–110), in which the case of low frequency evaluative prefixes like *mega-*, *super-*, etc., is treated. While the variable-corpus procedure assigns similar values to all these prefixes, the count of *h* heavily favors the most frequent one, namely *super-*, resulting in a complete lack of correlation between the two measures ($r = 0.27$).

## 4 Measuring productivity between inflection and derivation

After the discussion of the basic procedure adopted for assessing productivity quantitatively, let us delimit the domain of inflection with respect to derivation. It was mentioned above that it is commonsensical to assume inflection as more productive with respect to derivation. Let us see if this common opinion is also supported quantitatively.

In previous works (cf. Gaeta and Ricca 2002, 2003, 2006), the *P*-index was calculated for a number of Italian suffixes which basically belong to the deverbal and to the deadjectival domain:

(1) a. For the deverbal domain:

i. action nouns suffixes:

| | |
|---|---|
| *cambiare → cambiamento* | 'change' |
| *trasformare → trasformazione* | 'transformation' |
| *mappare → mappatura* | 'mapping' |
| *lavare → lavaggio* | 'washing' |
| *decadere → decadenza* | 'decay' |

ii. adjectival suffixes:

| | |
|---|---|
| *lavare → lavabile* | 'wash-able' |
| *mancare → manchevole* | 'faulty' |

b. For the deadjectival domain:

iii. quality nouns suffixes:

| | |
|---|---|
| *vero → verità* | 'truth' |
| *bello → bellezza* | 'beauty' |

iv. adverb-forming suffix: *fermo → fermamente* 'firmly'

v. elative suffix: *lungo → lunghissimo* 'very long'

In Table 5, the *P*-values for these suffixes are contrasted with the inflectional marker *-ava* at various *N*-values.

There is no space to discuss in detail the ranking of the single suffixes. What is relevant in the table, and testifies for the reliability of the methodology adopted, is that the ranking does not change with the progressive increase of the token number (cf. Gaeta and Ricca 2006 for details). Moreover, due to the sharp differences in token frequency, not all the affixes can be directly compared: the dark grey cells correspond to values of *N* which are too high for the least frequent affixes, with no available data. The value $N = 50{,}000$ is the most suitable to embrace the greatest number of affixes, but the lowest value of 19,000 is necessary to include the two less frequent ones, namely *-aggio*, and *-evole*, respectively. On the other hand, the data for the most frequent affixes cannot be fully reliable if calculated for excessively low values of *N*. Take for instance the paramount case of *-(z)ione*. For such a frequent suffix, the value

**Table 5** Italian suffixes ranked by productivity at different *N*-values

| Suffixes | $P(N) \cdot 10^3$ | | |
|---|---|---|---|
| | $N = 19{,}000$ | $N = 50{,}000$ | $N = 100{,}000$ |
| *-ava* | 32.8 | 13.4 | 7.1 |
| *-issimo* | 25.8 | 12.9 | |
| *-mente* | | 10.1 | 6.4 |
| *-bile* | 11.3 | 6.3 | 4.1 |
| *-ità* | | 6.3 | 3.7 |
| *-mento* | | 4.9 | 3.1 |
| *-(z)ione* | | | 2.7 |
| *-(t)ura* | 6.6 | 3.5 | |
| *-ezza* | 2.7 | 1.3 | |
| *-aggio* | 1.5 | | |
| *-(z)a* | 0.7 | 0.3 | 0.2 |
| *-evole* | 0.3 | | |

$N = 19{,}000$ is reached after about 1,300,000 corpus tokens, corresponding to a subcorpus size of just twenty days. Clearly, hapax legomena in a corpus of only 1,300,000 tokens can hardly be taken a priori as instances of very rare words, let alone new formations: many of them will simply be words with an average frequency of 1:1,000,000, which is manifestly still too high a value to consider them not to be stored in the mental lexicon (cf. Baayen 1994, p. 453). This distorting effect, which is again to be related to what has been said above regarding the steeply decreasing character of the *P(N)* curve in its initial stage, will reduce itself progressively as long as *N* increases: this means that the comparison between values for *P* becomes more reliable—whenever possible—at higher values of *N*. To emphasize the affixes mainly subject to this effect, in Table 5 (as well as in the rest of the paper) the less reliable values, i.e., those extracted from subcorpora under a threshold of 6,000,000 tokens (about three months of the newspaper) have not been reported and their corresponding cells marked with a light grey.

The suffixes group round three main sets: the very productive suffixes (*-ava*, *-issimo* and *-mente*), the moderately productive suffixes (*-bile*, *-ità*, *-mento*, *-(z)ione*, *-(t)ura*), and the scarcely or unproductive suffixes (*-ezza*, *-aggio*, *-(z)a*, *-evole*). Whereas the latter two sets include clearly derivational suffixes, the first group of suffixes is constituted by the clearly inflectional imperfect suffix *-ava*, the top scorer of the table, and by the slightly less productive elative suffix *-issimo* and by the adverb-forming suffix *-mente*, still less productive than *-issimo*. As for the latter two, they may be considered to represent border-line cases between inflection and derivation. In fact, there is no full consensus about which side they should be placed on: *-mente* is often seen as derivational (but cf. Haspelmath 1996, pp. 49–50 on its English equivalent *-ly*; for a discussion see Ricca 1998) and *-issimo* as inflectional (at least within the Italian tradition; but cf.

Gaeta 2003; Rainer 2003). Therefore, there is no wonder that they exhibit a higher productivity than any 'typically derivational' affix, with *-issimo*, arguably the more inflectional of the two, displaying a still higher value than *-mente*.

The quantitative evaluation of productivity may be said to mirror the so-called inflection/derivation continuum (cf. Dressler 1989; Plank 1994): inflectional productivity is always higher than for any other derivational suffix, with some borderline cases which lie in the middle of the continuum. As argued in Sect. 2, however, this finding *per se* does not help one to tease apart the two different souls of inflectional morphology, because the inflectional form *-ava* cumulates both the morpheme of inflectional class membership, namely the thematic vowel *-a-*, and the marker of the inflectional category imperfect indicative *-va*. The next sections will try to assess these two distinct aspects of inflectional morphology productivity separately.

## 5 The lexical nature of inflectional rules

Let us turn now to inflectional productivity only. The first investigation that can be carried out concerns inflectional class productivity. Is the latter to be interpreted against the syntactic dimension underlying inflectional productivity? Or is it rather a different phenomenon, much more similar to derivational productivity, as argued in Sect. 2? According to the first hypothesis, we should expect high *P*-values for all inflectional classes, even though showing different rankings, whereas the second hypothesis predicts that the *P*-values for less or unproductive inflectional classes should approach what we observe for less or unproductive derivational suffixes.

The following Table 6 reports the *P*-values for the 3rd person imperfect indicative of the three macroclasses of the Italian verb as well as the *P*-value for the whole inflectional category imperfect indicative represented by *-va*, calculated for two convenient *N*-values.

As expected (cf. Dressler and Thornton 1991; Orsolini and Marslen-Wilson 1997; Pirrelli and Battista 2000 for general overviews of Italian verb inflection), the class of *a*-verbs is the only really productive one, scoring a very high index. As for the other two, the interesting result is that their *P*-values are extremely low, matching the low *P*-values of scarcely productive derivational suffixes in Table 5. On the basis of similar data, Aronoff and Anshen (1998, pp. 246–247) lay down the generalization that

**Table 6** *P*-values for the three main Italian conjugational classes

| Suffixes | $P(N) \cdot 10^3$ | |
|---|---|---|
| | $N = 19{,}000$ | $N = 35{,}000$ |
| *-ava* | 32.8 | 18.4 |
| *-eva* | 4.0 | 2.3 |
| *-iva* | 3.4 | |
| *-va* | | 20.5 |

> "the productivity of inflectional rules is generally more polarized: they are likely to be either completely productive or completely unproductive, and there are very few in-between cases ... In the case of inflection, whose role is the realization of morphosyntactic information, which is always compositional, there is nothing for the speaker to call attention to, and hence less productive morphology has no role. Only productive morphology or lexicalized forms will surface".

Even if the data from the Italian verb classes apparently confirm the polarization assumed by Aronoff and Anshen, I am not sure whether this explanation really captures the difference occurring between productive and unproductive inflectional classes portrayed in Table 6. For instance, it is at least debatable whether the *i*-class has to be treated as lexicalized in Aronoff and Anshen's terms in opposition to the productive *a*-class, because it can be applied to new bases such as *immilanesire* 'to become Milanese' (cf. Dressler and Thornton 1991, p. 5). Thus, it proves to be at least marginally productive, adopting Haspelmath's (2002) criterion discussed in Sect. 2 above, not simply lexicalized, as laid down by Aronoff and Anshen.

Further evidence calling into question the clear-cut polarization suggested by Aronoff and Anshen comes from Orsolini and Marslen-Wilson (1997). On the basis of two psycholinguistic tests of lexical decision and of novel verbs production conducted on Italian speakers, the authors conclude that a dual mechanism approach, in which a regular, default inflection is opposed to irregular forms requiring lexical storage is not empirically supported, because regular inflection also "consults lexically listed features of the stem to which it applies, and does not apply unconditionally, even for stems to which no exceptions are specified" (Orsolini and Marslen-Wilson 1997, p. 33). Finally, Albright (2002) has further pointed out that for all inflectional classes certain 'islands of reliability' are of relevance for attributing inflectional class membership to novel verbs, independently of their regular or irregular status. In other words, the concepts of default and of regular versus irregular inflectional class are much more subtle than what a purely dual mechanism makes us believe.

At any rate, whatever might be the explanation for the state of affairs depicted in Table 6, this finding seems to support the second hypothesis laid down above, according to which inflectional class productivity is of a rather derivational nature. In this sense, less productive or even unproductive inflectional classes behave similarly to less productive or unproductive derivational suffixes. In fact, the same difference observed for productive and unproductive inflectional classes is reflected in deverbal derivational rules. In the following Table 7, the *P*-values for action noun suffixes like *-mento* and *-(z)ione* given in Table 5 have been calculated as discorporated between the different input verb classes.[8]

[8] For the sake of simplicity, deverbal nouns from the second and the third conjugational class have been grouped together. This also corresponds to the fact that both for the second and for third class the same input base occurs: *ripet-ere* → *ripeti-zione*, *defin-ire* → *defini-zione*. Moreover, a number of other allomorphies occur, especially with the suffix *-(z)ione*, that cannot be dealt with here (see, however, Gaeta 2002, pp. 66–71, 2005; Gaeta and Ricca 2006).

**Table 7** *P*-values for *-mento* and *-(z)ione* (discorporated between the input verb classes)

| Suffixes | $P(N) \cdot 10^3$ |
|---|---|
| | $N = 100{,}000$ |
| *-mento* | 3.1 |
| *-amento* | 2.9 |
| *-imento* | 0.6 |
| *-(z)ione* | 2.7 |
| *-azione* | 2.6 |
| *-(iz)ione* | 0.4 |

For both suffixes, a polarization similar to the one observed for the imperfect obtains between the *P*-values of the derivatives relating to the first declensional class and those relating to the other ones. Notice moreover that the absolute *P*-value of each suffix roughly converge with the *P*-value displayed by the *a*-class, both for the imperfect indicative and for the deverbal suffixes.

It must be added that the productivity of the *a*-class is supported by word formation processes, such as suffixation (with the three main verbalizing suffixes *-ifica-*, *-izza-*, and *-eggia-*), and conversion (e.g., *fieno* 'hay' → *fienare* '(V)', *pagina* 'page' → *paginare* '(V)', etc.), whereas for the other classes such options are mostly not available (with the minor exception of the *-ire* class fed by the so-called parasynthetic derivatives providing sporadic new formations occurring in the corpus such as *inflebilire* 'to become feeble'). This stresses the closeness of the latter two classes and raises an interesting theoretical question: should we only consider the *-amento* and *-azione* formations as the object of our productivity measure? The answer to this question is not trivial, and casts doubts on the very concept of productivity for derivational morphology, at least for deverbal rules, where the effect of inflectional class productivity is always covertly present. At any rate, it has been suggested that at least for derivational morphology it is necessary to speak of productivity only in relation to certain lexical domains covered by a given affix (cf. Koefoed and van Marle 2000, pp. 307–308), and the question raised here may probably be better understood if looked at from this viewpoint.[9]

## 6 The syntactic nature of inflectional categories

Let us now turn to the productivity of different inflectional categories. To the best of my knowledge, the latter question has been scarcely debated in the literature. I could only find a quick remark by Koefoed and van Marle (2000, pp. 303–304), who argue on the basis of Booij's (1996) dichotomy of inherent

[9] Notice that similar problems also arise for inflection, especially when calculating the productivity of inflectional classes on the basis of other inflectional categories as is the case of the Italian past participle. Since the range of variation is extremely high, in that several suffixation types occur (e.g., *lavare* 'wash'/*lavato*, *mettere* 'put'/*messo*, *temere* 'fear'/*temuto*, etc.) and cut across the inflectional class distinction (e.g., *immergere* 'immerse'/*immerso*, *comparire* 'appear'/*comparso*), is empirically impossible to tease the different properties apart.

and contextual inflection that "processes of contextual inflection typically possess an essentially unrestrained productivity". Furthermore, they add that "[m]any rules of inherent inflection (such as those in the realm of verb conjugation) reveal more or less the same picture. That is, those rules, too, exhibit the syntax-like kind of productivity that is characteristic to contextual inflection". As for noun plural, they concede, its productivity is less automatic, and "resembles that of the most unrestrained derivational processes".

Apart from this remark of a rather speculative character, the scarce attention paid to the productivity of inflectional categories might be due, among others, to the fact that English, the most investigated language in this field, displays a very poor inflectional system, with practically no synthetic inflection except for a couple of markers. Fortunately, Italian presents a rich system, in which several inflectional categories can be quite easily investigated. Six inherent inflectional categories of the Italian verb have been chosen as object of the investigation. I will not go into the details of possible morphological analyses for the investigated markers (see Matthews 1991, pp. 241–243, Spencer 1991, pp. 216–219), and rather take the whole ending of the third singular person of the imperfect indicative, of the so-called present conditional, of the imperfect subjunctive, and of the present future, respectively *parla-va*, *parle-rebbe*, *parla-sse*, and *parle-rà*, without distinguishing among the various inflectional classes. Moreover, the so-called gerund and the infinitive (cf. respectively *parla-ndo*, *parla-re*) have been compared.[10]

Before looking at the data, we have to clear the terrain from a number of possible objections relating to what to include into the counts. A first question concerns the imperfect indicative. Until now, we have been considering as representative for this inflectional class the suffixed form ending in *-va*. This choice excludes the suppletive form *era*, i.e., the imperfect indicative of the verb *essere* 'to be'. To make a proper comparison with the other inflectional categories, where the respective forms of *essere* are attested, albeit displaying a certain degree of allomorphy of the base (cf. in particular the conditional *sarebbe*, the future *sarà*, and the subjunctive *fosse*), one wonders whether the suppletive form should also be included into the count for *-va*. Arguably, the latter choice could be motivated by the paradigmatic force typical of inflection, and was in fact adopted in the following Table 8 for three convenient *N*-values.

Alternatively, one can categorically exclude all forms of the verb *essere*, avoiding possible distortions introduced by the comparison of non-rule based derivations, which are directly accessed in our mental lexicon just as any other simplex word. Arguably, they lie outside the domain of the *P*-index, which measures the probability of encountering new words formed with a certain affix (Table 9).

[10] The forms of the gerund and of the infinitive also occur in combination with clitic forms (e.g., *parlandole* 'speaking to her', *parlarle* 'to speak to her', and so on). These clitic-hosting forms have been however neglected in the following calculations, because they constitute a sort of 'outer-cycle derivation' with respect to the clitic-less forms. At any rate, as demonstrated in Gaeta and Ricca (2003, 2006), the impact of 'outer-cycle derivations' on the productivity measure is irrelevant within a variable-corpus approach.

**Table 8** *P*-values for different Italian inflectional categories (including the suppletive forms of *essere* 'to be')

| Inflectional categories | Suffixes | $P(N) \cdot 10^3$ | | |
|---|---|---|---|---|
| | | $N = 19{,}000$ | $N = 35{,}000$ | $N = 140{,}000$ |
| infinitive | *-re* | | | 6.1 |
| imperfect indicative | *-va* | | | 5.7 |
| gerund | *-ndo* | | 21.6 | 5.6 |
| imperfect subjunctive | *-sse* | 20.0 | 17.3 | |
| present future | *-rà* | | 13.7 | 4.5 |
| present conditional | *-rebbe* | 16.0 | 10.6 | 3.9 |

**Table 9** *P*-values for different Italian inflectional categories (excluding the forms of *essere* 'to be')

| Inflectional categories | Suffixes | $P(N) \cdot 10^3$ | | |
|---|---|---|---|---|
| | | $N = 19{,}000$ | $N = 35{,}000$ | $N = 140{,}000$ |
| infinitive | *-re* | | | 6.1 |
| imperfect indicative | *-va* | | 20.4 | 5.9 |
| gerund | *-ndo* | | 21.6 | 5.6 |
| imperfect subjunctive | *-sse* | 31.7 | 19.3 | |
| present future | *-rà* | 24.1 | 15.3 | 4.7 |
| present conditional | *-rebbe* | 17.9 | 11.5 | |

Although the *P*-values are different in the two tables because of the strong impact of *essere* in terms of token number, a clear pattern emerges:[11] the infinitive, the gerund and the imperfect indicative appear to be more productive than the other inflectional categories. This finding falsifies at least the strongest version of Koefoed and van Marle's (2000) claim mentioned above that verb inflection, either of a contextual or of an inherent nature, displays the same productivity values. Recall that the inflectional categories considered here all belong to the inherent side.

Before commenting further on this pattern, let us however discuss another possible objection relating to what to include into the counts. In fact, the two auxiliaries *essere* and *avere* also contribute to form periphrastic combinations for other inflectional categories, namely the past infinitive (*essere andato*, *avere parlato*), the past perfect (*era andato*, *aveva parlato*), the past gerund (*essendo andato*, *avendo parlato*), the past perfect subjunctive (*fosse andato*, *avesse parlato*), and the past conditional (*sarebbe andato*, *avrebbe parlato*). As argued by Börjars et al. (1997), periphrastic combinations occupy the cells of an inflectional paradigm similarly to any other inflected form, because for istance they exhibit the same sorts of semantic idiosyncrasies as simple forms. Accordingly, one might want to exclude from the count what belongs to periphrastic combinations, in order to avoid mixtures across different inflectional categories. Since it is practically impossible to distinguish in my corpus between the different usage of auxiliary and of simple verb, in the following Table 10 the

[11] The small deviation occurring in the case of the gerund *-ndo* and the imperfect *-va* must be presumably interpreted as a scarce significance of the ranking between the two suffixes, which also emerges from further calculations (see Table 10).

**Table 10** *P*-values for different Italian inflectional categories (excluding the auxiliaries *essere* 'to be' and *avere* 'to have')

| Inflectional categories | Suffixes | $P(N) \cdot 10^3$ | | |
|---|---|---|---|---|
| | | $N = 19{,}000$ | $N = 35{,}000$ | $N = 140{,}000$ |
| infinitive | *-re* | | | 6.1 |
| imperfect indicative | *-va* | 34.9 | 22.0 | 6.0 |
| gerund | *-ndo* | | 21.6 | 5.6 |
| imperfect subjunctive | *-sse* | 32.0 | 19.7 | |
| present future | *-rà* | 24.1 | 15.3 | 4.7 |
| present conditional | *-rebbe* | 19.5 | 12.6 | |

*P*-values of the inflectional categories have been calculated excluding both auxiliaries.

Once again, despite the tiny differences, the same pattern observed before emerges: the different inflectional categories do not display the same *P*-values. As expected on the basis of what has been discussed above contrasting inflection and derivation, the *P*-values generally remain quite high. However, the inflectional categories usually employed to convey what might be called a non-objective content (cf. Palmer 1986, p. 16), i.e., the imperfect subjunctive, the present future, and the present conditional, clearly display a lower *P*-value with respect to the infinitive, the imperfect indicative, and the gerund. It must be stressed that this difference cannot be due to a different frequency of employment of the inflectional categories, given that frequency is kept under control within the variable-corpus approach adopted here.

The limits on the productivity of these inflectional categories might in fact be connected with their non-objective content. Following this suggestion, the effect on productivity might be due to the extensive employment of modal verbs in a substitutive function in contexts like the following sentence:[12]

(2) *Mario auspicava che Sara parlasse/potesse parlare con sua madre per risolvere il problema.*
'M. hoped that Sara would/might talk to her mother to solve the problem'.

And this in a language like Italian in which verb inflection is usually considered to be not undermined by any strong tendency towards analyticity as has been massively the case in English or even in German, in which verbal periphrases by and large replace the inflected verbal forms (cf. Eisenberg 1999, pp. 122–123 for a discussion of German, and Bybee 2003 for a general picture). In other words, we might expect a hindering effect on the productivity of these inflectional categories because of the usage of such periphrases, which would prevent new hapaxes to be produced, simply because new instances of the periphrasis 'modal + infinitive' are used instead of the inflected verb form. If this is so, we should expect a much more limited type number *V* for the less pro-

[12] Notice that also the imperfect indicative may be used to convey counterfactual modality and may be replaced by a modal periphrasis: *Se Mario arrivava prima*, *prendeva/poteva prendere il treno* 'If Mario had arrived earlier, he might have caught the train'. However, this usage is far less frequent than the dominant imperfective meaning.

**Table 11** The impact of modals on the inflectional categories considered (auxiliaries excluded)

| Inflectional categories | Suffixes | *V* | Modals in $N_{max}$ (%) |
|---|---|---|---|
| infinitive | *-re* | 5,599 | 1.3 |
| gerund | *-ndo* | 3,995 | 0.7 |
| imperfect indicative | *-va* | 3,580 | 11.9 |
| present future | *-rà* | 2,575 | 14.8 |
| present conditional | *-rebbe* | 1,571 | 60.3 |
| imperfect subjunctive | *-sse* | 1,165 | 19.3 |

ductive categories because of the substitutive role played by modals, which would reduce the *h*-to-*N* relation by making *h* smaller. Furthermore, we should also expect a high impact of modals on the global token number $N_{max}$ of the single inflectional categories, reducing the *h*-to-*N* relation by making *N* larger.[13]

Both expectations are in fact borne out by the data as shown in the Table 11.

The inflectional categories connected with modality display a substantially lower type number *V*, accompanied by a significant contribution in terms of tokens of the three modals *dovere* 'must', *potere* 'can', and *volere* 'will' to the $N_{max}$ of the respective inflectional categories. Especially for the subjunctive *-sse* and the conditional *-rebbe*, the numbers remove any doubt that the modals do play a relevant role in limiting their productivity. As for the future *-rà*, its position is less clear, even though the distance from the more productive categories is well expressed in terms of *V*. There might surely be further structural factors playing a role here. For instance, the very frequent epistemic value of the future (cf. Bertinetto 1986, pp. 495–498) is likely to contribute to keep the type number pretty high while the impact of modals in terms of tokens remains low. For it is not enhanced by the competing presence of a substitutive periphrasis which would have to be in the conditional mood:

(3) *A quest'ora Mario dormirà*/**potrà* ~*potrebbe dormire*
'Mario might be sleeping now'.

In other words, the substitutive periphrasis turns out to feed not the token number of modals expressing future, but the token number of the conditional, which also explains the huge contribution of modals to the token number of this latter inflectional category emerging from Table 11.

An anonymous reviewer questions whether it would not to be expected that, if it is so that modals influence the performance of conditional, future and subjunctive, we should find converging *P*-values across all categories by leaving modals out of the calculation. This is supposed to be so because of the impact of modals on *N*, which is parasitically enlarged. However, even if it is true that the decrease of the *N*-values enhances the *P*-values, the modals' reductive impact on *h* cannot be grasped by leaving them out. Thus, similar diverging results are expected. This is evidently the case for the gerund and the infinitive, given the low contributions of modals to their $N_{max}$, as can be gathered from

[13] I thank an anonymous reviewer for helping me to clarify this aspect.

**Table 12** *P*-values for different Italian inflectional categories (excluding the auxiliaries *essere* 'to be' and *avere* 'to have', and the modals *dovere* 'must', *potere* 'can', and *volere* 'will')

| Inflectional categories | Suffixes | $P(N) \cdot 10^3$ $N = 30{,}194$ |
|---|---|---|
| imperfect indicative | *-va* | 25.4 |
| imperfect subjunctive | *-sse* | 23.5 |
| present conditional | *-rebbe* | 18.1 |
| present future | *-rà* | 18.0 |

Table 11. But this is also the case for the other categories considered, as shown in the Table 12.

Probably, there are other features involved here, for instance the incidence of other periphrases which also might potentially have a similar effect of reducing *h*. To mention a couple of possible cases, the progressive periphrasis formed by '*stare* + gerund' (e.g., *Anna stava tornando a casa*. 'Anna was coming back home') as well as the continuous periphrasis formed by '*andare*/*venire* + gerund' (e.g., *Anna andava*/*veniva accumulando buoni risultati*. 'Anna kept accumulating good results') might be of interest here (cf. Bertinetto 2003, pp. 89–116 for a more detailed picture). Clearly, these periphrases are not only specific of modals: their impact should concern all four inflectional categories, including the imperfect indicative. The same holds true for other two periphrases which might exert an influence on the productivity of the inflectional categories at stake here, by enlarging *N*. These are the other two passive periphrases formed respectively by means of the auxiliaries *andare* and *venire*:

(4) a. *Maria veniva accompagnata a casa spesso.*
'Mary was often accompanied back home'.

b. *Maria andava accompagnata a casa spesso.*
'Mary often had to be accompanied back home'.

As was argued for above, one would like to exclude these auxiliaries because they might be considered part of the paradigm of other verbs. Table 13 reports data for the inflectional categories at stake, excluding all these verbs.

The *P*-values do not converge, which confirms that simply excluding the auxiliaries from the token number does not do justice of the reductive effect in terms of *h* exerted by the periphrases onto the single inflectional categories, and especially those in competition with modals.

However, an interesting pattern emerges from Tables 12 and 13. In fact, the *P*-values of the indicative and of the subjunctive imperfect, respectively *-va* and *-sse*, as well as of the future and of the conditional, respectively *-rà* and *-rebbe*, roughly converge. One plausible explanation of this fact might be that this distribution mirrors, at least partially, their inherent semantic values, in that on the one hand we find two imperfective tenses. On the other, there are two tenses, the future and the conditional, which display, besides a common

**Table 13** *P*-values for different Italian inflectional categories (excluding the auxiliaries *essere* 'to be', *avere* 'to have', *andare* 'to go' and *venire* 'to come', and the modals *dovere* 'must', *potere* 'can', and *volere* 'will')

| Inflectional categories | Suffixes | $P(N) \cdot 10^3$ $N = 22{,}623$ |
|---|---|---|
| imperfect indicative | *-va* | 32.9 |
| imperfect subjunctive | *-sse* | 31.4 |
| present conditional | *-rebbe* | 23.0 |
| present future | *-rà* | 22.5 |

diachronic origin,[14] a number of synchronic commonalities, especially relating to a certain 'attenuative' subjective modality manifested in sentences like (cf. Bertinetto 1986, p. 487):

(5) a. *Non dirò che fossi soddisfatto, però non protestai.*

b. *Non direi che fossi soddisfatto, però non protestai.*
'I won't say that I was satisfied, but I didn't protest'

Furthermore, they both convey epistemic modality, in that the future expresses a pure conjecture, and the conditional is rather reportive (cf. Lepschy and Lepschy 1994, p. 209):

(6) a. *Il criminale si troverà* ancora nei dintorni.
'The criminal will still be in the neighborhood'.

b. *Il criminale si troverebbe ancora nei dintorni.*
'The criminal is supposed to still be in the neighborhood'.

Finally, they also share a common futural meaning, which used to be quite common for the conditional in older stages of Italian as future in the past and can still be used nowadays in certain particular contexts (cf. Lepschy and Lepschy 1994, p. 209):

(7) a. *Maria dice che verrà* volentieri fra due giorni.

b. *Maria dice che verrebbe volentieri fra due giorni.*
'Mary says that she would like to come in two days'.

Again, we observe structural properties of these inherent inflectional categories reflected into their behavioral performances. How far such relations are directly grasped by the productivity of the inflectional categories is a difficult question, but the variable-corpus approach outlined here may at least make one sense the existence of such scenarios. At any rate, the question is really intricate and must be left open for future and more detailed research.

[14] As is well known, the Italian future and conditional go back to periphrases based respectively on the indicative present and perfect of the Lat. HABĒRE plus the verbal infinitive. These periphrases were then grammaticalized in Italian as well as in other Romance languages (cf. Squartini 2004 for a broader picture).

## 7 Conclusion

Summing up, the double nature of productivity for inflection has been given a quantitative support with the help of the variable-corpus approach to productivity. Besides confirming the conceptual and empirical validity of the variable-corpus approach, the latter has also allowed us to show how distinct the two aspects of productivity are for inflectional morphology. On the one hand, the potential of inflection is restricted in a way that resembles lexically-conditioned limitations of derivation, reflected in lower *P*-values for less productive or unproductive inflectional classes as in typical word formation rules. Among others, this creates empirical problems for assessing the productivity of especially deverbal derivation, because a covert impact of inflectional class productivity lurks there.

On the other, the syntactic function of inflection is of paramount importance to define the high productivity of inflection with respect to derivation, which is also mirrored in quantitative analyses of single inflectional categories. For the latter, differences in productivity have been observed, which rely on well-characterized structural factors limiting the exploitation of the huge syntactic potential of inflection. Notice that these differences concerned inherent inflectional categories: As for purely contextual inflection like the singular and the plural for verbs, no significant differences were observed. This partially supports Koefoed and van Marle's (2000) claim that contextual and inherent inflection should behave differently.

Furthermore, the differences among the inflectional categories might help one to shed light on a number of related phenomena having to do with the decay of inflectional categories in languages like English or German, in which modals or other auxiliaries developed in such a massive way to decree the collapse of inflectional categories of the verb. In this respect, it is interesting to observe that even in a language like Italian, in which modals are usually not attributed any auxiliary-like role, the linguistic signal contains clearly identifiable cues or symptoms of what in other languages has given rise to dramatic changes in the morphosyntactic system. In other words, one can come up with the hypothesis that there seems to be a general tendency for modals to play a substitutive role for other inflected forms, which may be detected even in a richly inflecting language like Italian.

With the caveat of becoming exceedingly speculative here, one may even ask whether these cues are the signal of an incipient development of Italian morphosyntax, in that modals will undergo a more robust auxiliarization process. Even if a negative answer will turn out to be correct here, one can nonetheless emphasize the discovery of a usage-based tendency for modals to play a substitutive role for those inflectional categories to which they are functionally close. This tendency has been shown to have consequences on the productivity of the competing inflectional categories. To what extent such a tendency is universal must be left as an open question for future empirical research on a wider language sample. At any rate, this finding shows that the linguistic signal is much richer than one ever thought to be, and strongly encourages further investigations based on large text corpora.

Finally, the differences in productivity are also likely to reflect the inherent value of the single inflectional categories, which behave similarly according to the conveyed intrinsic meaning and to the syntactic options available. Again, this shows how complex the notion of productivity is, and how many factors may play a role in influencing it. It is to be hoped that future research will tackle these problems in a direct way on different languages, in order to assess the role of inflectional category productivity in its tight relation with other components of language, and in particular syntax. The variable-corpus approach provides a reliable procedure to carry out such a far-reaching investigation.

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